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The Efficiency of Border Strip Irrigation Practices in Alberta

Explanatory

This publication provides information on the efficiency of various methods of irrigation water application as determined in irrigated fields of southern Alberta.

As only approximately one-third of the water diverted for irrigation purposes ends up in the soil for crop use, knowing where and how losses occur is the first step in improving irrigation water management practices. How effectively irrigation water is stored and distributed on a border strip irrigated field is called "farm irrigation efficiency". Other aspects of irrigation water management such as reservoir, storage, conveyance and canal system distribution losses are not dealt with here.

Definition of terms

The **border strip** is an area of land bounded by two border ridges, dikes, or ditches that guide the irrigation stream from a point or points of application to the ends of the strip.

The **border ditch system** uses a ditch as a divider between individual strips. The ditch carries irrigation water which is applied at different locations along the entire length of the field.

The **border dike system** uses dikes on both sides of the strip and the irrigation water is supplied only at the upper end of the strip.

Farm irrigation efficiency is the percentage of the water applied at the farm gate which is stored in the soil for crop use. It is expressed in the formula:

$$\text{Farm irrigation efficiency} = \frac{\text{Water stored in the soil}}{\text{Water delivered at the farm gate}} \times 100$$

The major losses in surface irrigation are: surface runoff, deep percolation and evaporation.

Surface runoff occurs at the lower end of the border strip when the water which has not penetrated the soil runs off. When using the border strip system it is rare for there to be no runoff. In fact no runoff often means that insufficient water had been applied.

Deep percolation loss is the amount of water which penetrates beyond the depth of the root zone where it is no longer available to a growing crop. Large deep percolation losses occur in gravelly or sandy soil or where more than adequate water has been applied.

Farm efficiency values

To calculate farm irrigation efficiency, field tests were conducted which measured water applied, surface runoff, and the increase in the amount of water in the soil after irrigation.

Border dike systems

Tests were conducted between 1960 and 1968 by the former water resources branch of Alberta Agriculture. The data are summarized Table 1.

As seen in Table 1 there are wide variations found in runoff, deep percolation, and the percentage of water stored in the soil. Heavier applications of irrigation water tend to result in a lower efficiency and more deep percolation losses. Slope, soil texture, width and length of the strip had no significant correlation with irrigation efficiency.

Copies of this and related publications may be obtained from the Print Media Branch, Alberta Agriculture, 7000 - 113 Street, Edmonton T6H 5T6 or Alberta Agriculture's District Offices.

Table 1: Border dike water application efficiency

Amount of irrigation water applied	Downfield slope (per cent)	Width of strip (m)	Length of strip (m)	Surface runoff (per cent)	Deep percolation (per cent)	Water stored in the soil (per cent)	
Under 127 mm	Range 0.4-2.5	Range 6-30	Range 122-366	2-35	0-38	Range 65-90	Average 77
Over 127 mm	Range 0.2-0.8	Range 6-9	Range 213-274	8-26	26-65	Range 35-88	Average 54
Average 107 mm	0.6	8.2	241	18	13	–	70

Border ditch system

Data collected on the efficiency of border ditch irrigation in 1977 and 1978 by the Alberta Agriculture irrigation division are summarized in Table 2.

According to test results, surface runoff was quite small but major losses occurred through deep percolation. The overall water storage (efficiency) figure was 50 per cent which shows that, in general, border ditch systems are considerably less efficient than the border dike systems (70%).

The main reason for this is the wide ditch spacing (26 m) on sandy soils. In order to avoid deep percolation, enough water must be applied to cover the strip in less than two hours. In the majority of cases this would amount to much more than an ordinary farm ditch could supply. The insufficient water supply would cause the water to be in the strip for perhaps four hours instead of two, resulting in a reduction in efficiency of 50 per cent.

It is important to note that high efficiency by definition does not always mean good irrigation practice. If a very small amount of water is applied it is likely to produce insignificant runoff and no deep percolation loss with the result that almost 100 per cent is stored in the soil. This gives a high efficiency value but is not a good irrigation practice because most of the root zone is still dry after the irrigation.

In general, higher farm irrigation efficiency is the result of better management practices. Extremely high surface runoff and deep percolation losses should be avoided. However, a farm irrigation efficiency of 70 to 80 per cent is attainable with careful management.

Care and attention paid to good irrigation practices seems to be the most important factor in increasing farm water management efficiency.

Table 2. Border ditch water application efficiency

	Water applied (mm)	Downfield slope (per cent)	Length of strip (m)	Width of strip (m)	Surface runoff (per cent)	Deep percolation (per cent)	Water stored in the soil (Efficiency) (per cent)
Range	68-201	0.08-0.75	38-1487	16-30	0-8	8-84	16-84
Average	127	0.38	474	26	1	49	50

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